# 23. ITS ARCHITECTURE

## BASIC REQUIREMENT

Intelligent Transportation Systems (ITS) projects funded by the Highway Trust Fund and the Mass Transit Account must conform to the National ITS Architecture, as well as to United States Department of Transportation (USDOT) adopted ITS Standards.

## AREAS TO BE EXAMINED

1. ***Regional ITS Architecture Conformance***

2. ***Systems Engineering Analysis***

## REFERENCES


1. TEA-21, PL 105-178, Section 5206(e)
2. 23 USC Section 502, Surface Transportation Research
3. Federal Register: January 8, 2001 (Volume 66, No. 5, pp. 1455-1459) "FTA National Architecture Policy on Transit Projects"


## USEFUL WEBLINKS

Systems Engineering for Intelligent Transportation Systems

Systems Engineering Guidebook for ITS

Systems Engineering and ITS References

Systems Engineering Management Plan

# QUESTIONS FOR THE REVIEW

**1.** *Is the grantee attempting to deploy ITS technologies? If yes, are ITS projects and programs part of a locally approved Regional ITS Architecture?*

**EXPLANATION**

FTA grantees may deploy many types of ITS technologies and projects. An ITS project is defined in the ITS Architecture Policy Guidance as "any project that in whole or in part funds the acquisition of technologies or systems of technologies that provide or significantly contribute to the provision of one or more ITS User Services as defined in the National ITS Architecture." Thus, if the project includes ITS components that implement any of the defined User Services, it is considered an "ITS project." There are currently 33 User Services, organized in eight User Service Bundles, represented within the National ITS Architecture. The User Services most likely to be proposed/implemented by an FTA grantee include:

- Travel and traffic management
  - Pre-trip travel information
  - En-route driver information
  - Route guidance
  - Ride matching and reservation
  - Traveler services information
  - Traffic control
  - Incident management
  - Travel demand management
  - Emissions testing and mitigation
  - Highway rail intersection
- Public transportation management
  - En-route transit information
  - Personalized public transit
  - Public travel security
- Electronic payment
  - Electronic payment services
- Emergency management
  - Emergency notification and personal security
  - Emergency vehicle management
  - Disaster response and evacuation
- Advanced vehicle safety systems
  - Longitudinal collision avoidance
  - Lateral collision avoidance
  - Intersection collision avoidance
  - Vision enhancement for crash avoidance
  - Safety readiness
  - Pre-crash restraint deployment
  - Automated vehicle operation
- Information management
  - Archived data function
- Maintenance and construction management
  - Maintenance and construction operations

Examples of systems that may be implemented as part of transit ITS projects are:

- Pre-trip traveler information systems through phone, 511 systems, kiosks, the web, and other electronic channels that help provide route and fare information or itinerary planning
- En-route transit information through 511 systems, variable message signs, enunciators, or personal devices that provide next vehicle and stop information, or route and itinerary planning
- Multi-modal traveler information systems that integrate transit information with highway, rail, and other options
- Personalized public transit for route deviation, flex route, and paratransit services
- Transit management systems and management centers using AVL, computer aided dispatch, GIS, and surveillance of network conditions to improve the travel time and reliability of the transit system, and provide for transfer connection protection
- Transit signal priority to improve the travel time and reliability of the transit vehicles operating in mixed flow, or crossing major arterials at grade
- Carpool ride matching and reservation systems
- Electronic payment systems both at transit centers and stations and on vehicles that include both fare payment and the ability to pay for other services (parking or toll charges)
- Communications systems that provide the backbone for the vehicle and wayside communication to each other and to the transportation management center
- Automatic passenger counters for performance monitoring and service planning
- Vehicle and system monitoring that tracks system functions and provides warning of likely malfunction or maintenance needs
- Vehicle, stop or wayside surveillance to provide for passenger, driver and system safety and security. Silent alarms to notify authorities of an incident or emergency.
- Highway/rail intersection protection to improve the safety of rail transit operations and buses that travel through rail intersections

- Collision warning/avoidance, vision enhancement and driver assistance to ensure safe transit operations in increasingly congested conditions, or limited rights of way
- Data archiving and information management systems to store and analyze the real time system data and assist in service planning, system monitoring and other decisions

Inter-agency cooperation is the major objective of the Regional ITS Architecture. ITS projects include comprehensive management strategies that apply technologies in an integrated manner. The purpose of ITS integration is to facilitate institutional integration through sharing information and reducing redundant spending between jurisdictions. ITS integration includes both technical and inter-agency aspects of system development.

One example of institutional integration is sharing information between transit, arterial and freeway agencies to improve the speed and schedule reliability of buses on the transportation network. Another type of integration is when agencies use technologies that are compatible with each other, such as traffic signals and emergency vehicle preemption to enable emergency vehicles to respond faster. ITS projects are those that contribute to the provision of one or more ITS user services as described above.

The Regional ITS Architecture is a tool that is used in transportation planning, programming, and project implementation for ITS. It is a framework for institutional agreement and technical integration for ITS projects and is the place to start when defining the basic scope of a project. The FTA grantee is not likely to be the lead agency for creating and updating the Regional ITS Architecture. The lead agency may be the MPO or the state department of transportation. The grantee needs to be an active participant in the Regional ITS Architecture development and maintenance if the grantee is implementing ITS projects. For reasons discussed above, the grantee's ITS projects must be included in the locally approved Regional ITS Architecture.

### REFERENCE

National ITS Architecture
PL 105-178 Section 5206(e)
Federal Register: January 8, 2001 (Volume 66, No. 5, pp. 1455-1459)

### SOURCES OF INFORMATION

The reviewer will ask the grantee to provide a description of the scope of ITS projects, an operational concept that identifies the roles and responsibilities of the participating agencies, the functional requirement of ITS projects and the interface agreements and information exchanges between ITS projects and other planned and existing systems and subsystems. The reviewer also will examine work statements in requests for proposals, project design documents, system documentation delivered by a contractor, or the Regional ITS Architecture.

The grantee will be asked to provide documentation, typically excerpts from the Regional ITS Architecture, showing that the major architecture elements for ITS projects are included in the locally approved Regional ITS Architecture.

### DETERMINATION

The grantee is deficient if ITS projects are not included in the Regional ITS Architecture. The grantee is deficient if the final design of the ITS project is inconsistent with the regional architecture.

### SUGGESTED CORRECTIVE ACTION

The grantee will be directed to establish and submit to the FTA regional office a plan to have its ITS projects included in the Regional ITS Architecture. The grantee will be directed to submit documentation to the FTA regional office that it has worked with the lead Regional ITS Architecture agency to incorporate any omitted elements in an update to the Regional ITS Architecture.

**2.** *Has the grantee established a process for the systems engineering analysis of ITS projects that addresses the seven prescribed steps? Has it applied the process? If the project scope has changed, has it reviewed the systems engineering analysis and, if necessary, updated it?*

### EXPLANATION

FTA grantees are required to follow a systems engineering analysis in implementing an ITS project. Systems engineering reduces the risk of schedule and cost overruns and increases the likelihood that the implementation will meet the user's needs. If there are changes to the scope of the project, such changes must be reflected in the systems engineering analysis for it to be effective.

The systems engineering analysis process is intended to address the potential risk associated with an ITS project because ITS projects often are not fully successful. This is especially true of ITS projects that include new technology, new software, new communications, or joint efforts with external partners.

FTA's ITS Architecture Policy prescribes the following seven steps for the systems engineering analysis:

1. Identify portions of the Regional ITS Architecture being implemented. Show where the elements of the ITS project is in the Regional ITS Architecture.
2. Identify participating agency's roles and responsibilities. Define for each participating agency.
3. Define requirements. What functions will the ITS system need to perform?
4. Analyze alternative system configurations and technology options to meet the requirements. What other options were examined?
5. Analyze financing and procurement. How will the ITS project be funded, procured and maintained?
6. Identify ITS standards and testing. Identify applicable ITS standards and testing procedures.
7. Identify procedures and resources necessary for operations and management. How will the ITS project be operated and maintained?

In addressing the risks associated with ITS projects, it is prudent for the implementing agency or agencies to determine whether the ITS project is low risk or high risk in nature. With low risk projects, a simplified system engineering process can be utilized or in some cases none at all. Risks for an ITS project can be determined by assessing the following eight characteristics:

1. Jurisdiction. Does the ITS project include a single or multiple jurisdictions?
2. Software, commercial-off-the-shelf (COTS). Does the project require software development or can rely entirely on existing and proven software?
3. Hardware. Does the project require development of hardware or does proven hardware exist?
4. Interfaces. Does the project require new interfaces or will it rely entirely on existing interfaces?
5. Requirements. Will the project's requirements be well defined and fully documented prior to procuring the system?
6. Procedures. Will the project's operating procedures be well documented prior to procuring the system?
7. Technologies. Does the project only use proven and stable technologies?
8. Staff experience. Does the staff implementing the project have prior experience with ITS procurement, implementation and operations?

When the scope of an ITS project changes, the grantee must update the systems engineering analysis to reflect all revisions.

## REFERENCE

PL 105-178 Section 5206(e)
Federal Register: January 8, 2001 (Volume 66, No. 5, pp. 1455-1459)

## SOURCES OF INFORMATION

The reviewer will determine whether the ITS project is a high risk project by discussing the eight characteristics listed under the risk discussion above. If the project is high risk, the grantee will be asked to demonstrate that the system engineering analysis addressed the seven steps.

## DETERMINATION

The grantee is deficient if it has not established a process for the systems engineering analysis of ITS projects and it has not applied the process to its ITS projects.

## SUGGESTED CORRECTIVE ACTION

The grantee will be directed to develop and submit to the FTA regional office a process for the systems engineering analysis of ITS projects.